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# Hospitalizations and deaths from diabetes mellitus in northeastern Brazil between 2010 and 2019

*Internações e óbitos por diabetes mellitus no nordeste brasileiro entre 2010 e 2019*

*Hospitalizaciones y muertes por diabetes mellitus en el noreste de Brasil entre 2010 y 2019*

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**Abstract**

**Objective:** To identify the epidemiological profile of hospitalizations and deaths due to Diabetes *Mellitus*, based on secondary data, in the Northeastern Brazilian States, between 2010 and 2019. **Methods:** Ecological, time series study that used secondary data extracted from the website of the Department of Informatics of the Unified Health System (DATASUS). The population of this study consisted of all hospitalizations and deaths due to Diabetes *Mellitus* of people living in the Northeastern Brazilian States during the period investigated. The following variables were investigated: age group; sex; color/race; character of care due to hospitalization and deaths due to Diabetes *Mellitus*. **Results:** During the period there were fluctuations in the mortality rate, with a decreasing trend, but without statistical significance (p=0.0523). It was observed that older adults, women and browns are more frequent among hospitalizations. In addition, it was found that the older adults suffered more emergency hospitalizations compared to elective ones. There was a statistically significant association in the variables, age group, sex and race and type of care (p<0.001). Older adults, women and browns are the most prevalent among deaths, regardless of the nature of care. **Conclusion:** Deaths and hospitalizations due to Diabetes *Mellitus* were more prevalent among older adults, female and brown patients, with a predominance of urgency in care.

**Keywords:** Diabetes *Mellitus*; Hospitalization; Mortality.

**Whats is already known on this?**
Diabetes *Mellitus* affects a high number of Brazilians and causes several hospitalizations and deaths, especially in older individuals, generating high costs resulting from the disease itself, as well as its complications.

**What this study adds?**
The mortality rate from Diabetes *Mellitus* in the Northeast showed a decreasing trend. In the northeast, hospitalizations and deaths mainly affect the older adults, women and browns, with a predominance of urgency.

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***Resumo***

***Objetivo:*** *Identificar o perfil epidemiológico das internações e dos óbitos por Diabetes Mellitus, a partir de dados secundários, nos estados do Nordeste brasileiro, entre 2010 e 2019.* ***Método:*** *Estudo ecológico, de série temporal, que utilizou dados secundários extraídos do site do Departamento de Informática do Sistema Único de Saúde (DATASUS). A população deste estudo foi composta por todas as hospitalizações e óbitos por Diabetes Mellitus de pessoas residentes nos estados do Nordeste brasileiro durante o período investigado. Investigou-se as seguintes variáveis: faixa etária; sexo; cor/raça; caráter de atendimento por internação e óbitos por Diabetes Mellitus.* ***Resultados:*** *Durante o período, houve flutuações na taxa de mortalidade, com tendência decrescente, mas sem significância estatística (p=0,0523). Observou-se que idosos, mulheres e pardos são mais frequentes entre as internações. Ademais, verificou-se que idosos sofreram mais internações de urgência em comparação às eletivas. Houve associação estatística significativa nas variáveis, faixa etária, sexo e raça e o tipo de atendimento (p<0,001). Idosos, mulheres e pardos são os mais predominantes entre os óbitos, independente do caráter de atendimento.* ***Conclusão:*** *Os óbitos e internações por Diabetes Mellitus foram mais predominantes entre pacientes idosos, do sexo feminino e pardos, com predomínio do caráter de urgência no atendimento.*

***Descritores:*** *Diabetes Mellitus; Hospitalização; Mortalidade.*

***Resumén***

***Objetivo:*** *Identificar el perfil epidemiológico de las hospitalizaciones y muertes por Diabetes Mellitus, a partir de datos secundarios, en los Estados del Nordeste brasileño, entre 2010 y 2019.* ***Método:*** *Estudio ecológico, de series temporales que utilizó datos secundarios extraídos del Departamento de Informática del Sistema Único de Salud (DATASUS). La población de este estudio estuvo compuesta por todas las hospitalizaciones y muertes por Diabetes Mellitus de personas residentes en los Estados del Nordeste brasileño durante el período investigado. Se investigaron las siguientes variables: grupo de edad; sexo; color/raza; carácter de la atención por hospitalización y muertes por Diabetes Mellitus.* ***Resultados:*** *Durante el período hubo fluctuaciones en la tasa de mortalidad, con tendencia decreciente, pero sin significancia estadística (p=0,0523). Se observó que ingresan con mayor frecuencia personas mayores, mujeres y mestizos. Además, se encontró que las personas mayores sufrieron más hospitalizaciones de emergencia en comparación con las electivas. Hubo asociación estadística significativa en las variables grupo etario, sexo y raza y tipo de atención (p<0,001). Las personas mayores, las mujeres y las personas mestizas son las que más predominan entre las defunciones, independientemente del tipo de atención.* ***Conclusión****: Las muertes y hospitalizaciones por Diabetes Mellitus fueron más prevalentes entre pacientes de edad avanzada, mujeres y mestizos, con predominio de la atención de urgencia.*

***Descriptores:*** *Diabetes Mellitus; Hospitalización; Mortalidad.*

## INTRODUCTION

Diabetes *Mellitus* (DM) is one of the main chronic non-communicable diseases (NCDs) and, therefore, is considered the main causal reason for deaths and disabled individuals worldwide, being, therefore, one of the most challenging diseases of the 21st century.[1] In addition to being a serious public health problem,[2] it stands out due to its great potential for long-term complications, as it affects the vascularization of people affected by the disease and plays an important role in increasing morbidity and mortality.[3]

At the microvascular level, lesions appear in the retina that can develop into irreversible blindness (retinopathies), problems in the blood vessels of the kidneys causing chronic kidney disease (nephropathies) and neuronal damage responsible for non-traumatic amputations of the lower limbs (neuropathies). At the macrovascular level, individuals can develop ischemic heart disease, cerebrovascular disease, and peripheral vascular disease, which often lead to hospitalization and therefore mortality.[4]

The Global Health Estimates pointed to DM as the ninth leading cause of death worldwide, with about 1.50 million deaths.[5] According to the Global Burden of Disease, in 2021 alone, 529 million people lived with diabetes, or 6.1% of the global population, and it is estimated that between 2021 and 2050, the global prevalence of age-standardized total diabetes will increase by 59.7% (95% CI= 54.7-66.0), resulting in 1.31 billion (95% CI=1.22-1.39) people living with diabetes in 2050.[2] Data from Brazil show that it affects a high number of Brazilians. In 2015, approximately 12 million Brazilians had DM and, in 2017, more than 14 million were estimated, which represents a significant increase in cases per year. These data place Brazil in fourth position in the group of countries that have the highest prevalence rates, behind only China, India and the United States.[6-7]

DM and other chronic comorbidities are conditions whose treatment is carried out at the level of Primary Health Care (PHC), [8] but complications during treatment can arise and, therefore, the need for hospital care becomes indispensable. These complications cause problems for the individual as a whole, impairing motor function, autonomy and quality of life, generating a strong future impact on the health and economy of individuals, family members and the global economy.[9]

Worldwide, direct costs related to the care of people with DM range from 2.50% to 15% of national health spending, depending on the local prevalence of cases and the need for more complex care available.[10] The total number of hospitalizations and complications resulting from it have a much higher

cost when compared to expenses with hospitalizations for adverse causes and their aggravations such as cancers or respiratory diseases, for example.[11]

Few studies analyze mortality trends for DM, especially in Northeastern Brazil, which is the region with the highest rate of hospitalization for DM.[12] Thus, a study was necessary to analyze hospitalization and mortality rates to configure data that assist in the creation of measures to mitigate DM-related diseases and consequently reduce the number of hospitalizations and their respective costs.[13] Therefore, the objective of this study was to identify the epidemiological profile of hospitalizations and deaths due to Diabetes *Mellitus*, based on secondary data, in the states of Northeastern Brazil, from 2010 to 2019.

## METHODS

Ecological, time series study that used secondary data extracted from the website of the Department of Informatics of the Unified Health System (DATASUS). Data extracted from DATASUS were recorded in the SUS Hospital Information System (SIH-SUS) and Mortality Information System of the Ministry of Health (SIM-MH). The Strengthening the Reporting of Observational studies in Epidemiology (STROBE) of the EQUATOR Network was used to guide and develop the research.[14]

The study population consisted of all hospitalizations and deaths due to DM of people living in the Northeastern Brazilian States during the investigated period: Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte and Sergipe. The Northeast region has a total area of 1,554,291 km² and approximately 57,071,564 million inhabitants.[15]

The following variables were investigated: age group; sex; color/race; character of care due to hospitalization and deaths due to DM. After collection in the information systems, the data were exported and tabulated in the Microsoft Office Excel® software, in which descriptive statistical analysis (absolute and relative frequency) was performed. The mortality rate was calculated by the ratio between deaths and hospitalizations for Diabetes *Mellitus*, and the result was multiplied by 100. It is noteworthy that the choice of variables was due to the availability in the information systems used.

Regarding the temporal analysis, it is noteworthy that the raw data of hospitalizations and deaths due to Diabetes *Mellitus*, in each year, after tabulated in a Microsoft Excel® spreadsheet, were imported into the free software Joinpoint Regression Program version 4.6.0.0(14). It is noteworthy that the aforementioned software was developed with the purpose of analyzing cancer trends; however it has been widely used, currently, in epidemiological research, due to its potential in the analysis of temporal patterns. The Annual Percentage Change (APC) was calculated using a 95% confidence interval (95% CI), in which negative and positive APC values indicate, respectively, a decreasing and increasing trend. In addition, each inflection point added to the model will represent a change in the linear trend.[16-17]

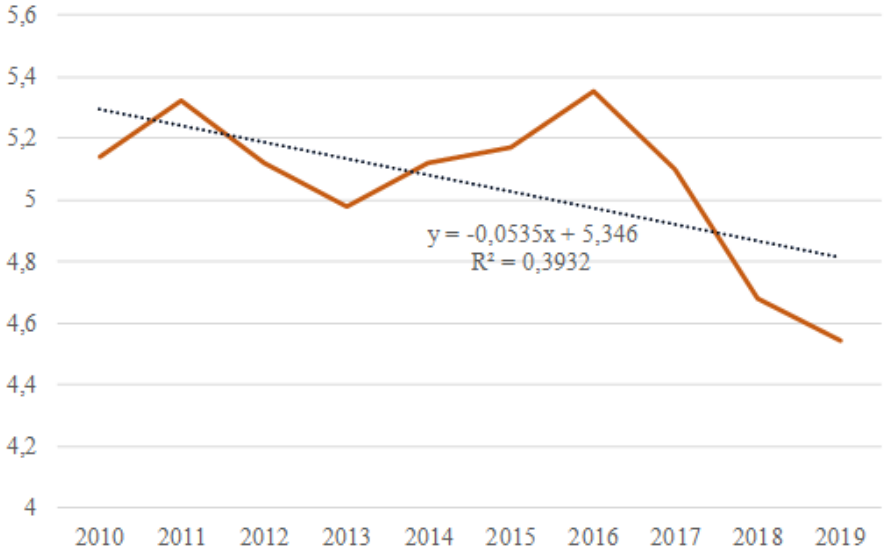
In addition, bivariate analyses were performed using the R software, version 4.0.2®, in which the Chi-Square independence test ($x^2$) and odds ratio (OR) were used. In the Chi-Square test ($x^2$), $p<0.05$ was considered necessary for the rejection of the null hypothesis. A 95% confidence interval (95% CI) was adopted, which was used to conclude about the Chi-Square hypothesis test ($x^2$), considering that if it contains the value 1, it means that there is no difference regarding the two investigated variables.[17]

It is noteworthy that this study used secondary data, which are openly available on the DATASUS website, which do not allow the identification of individuals and, therefore, there is no need for evaluation by the Research Ethics Committee (REC). However, it is noteworthy that all ethical precepts of the relevant legislation were respected, in accordance with resolutions 466/12 of the National Health Council, which deals with aspects of human dignity and 580/18, which deals with ethical aspects in research of strategic interest to the Unified Health System (SUS).

## RESULTS

It was observed that during the investigated period there were fluctuations in the mortality rate. The dotted line shows a decreasing trend, but it did not show statistical significance (p=0.0523) (Graph 1).

**Graph 1.** Mortality rate in the analyzed period. Floriano, PI, Brazil, 2021.




**Source:** research data (2021).

Table 1 shows that older patients suffered more emergency hospitalizations compared to elective hospitalizations. There was a statistically significant association in the variables, age group, sex and race and type of care (p<0.001). It was found that the age group from 30 to 39 years (OR=1.17), as well as women (OR=1.07) and individuals of mixed race (OR=1.24) have more chances of emergency care than elective.

**Table 1.** Hospitalizations by nature of care according to age group, sex and race. Floriano, PI, Brazil, 2021.

| Variables | Character of service | | | | P-value | CR (95% CI) |
|---|---|---|---|---|---|---|
| | Elective | | Urgency | | | |
| | n | % | n | % | | |
| **Age group** | | | | | **<0.001** | |
| Less than 10 years | 494 | 1.83 | 6.835 | 1.63 | | 0.89 (0.81 - 0.98) |
| 10 to 19 years | 891 | 3.30 | 12.465 | 2.98 | | 0.9 (0.84 - 0.96) |
| 20 to 29 years | 713 | 2.64 | 12.256 | 2.93 | | 1.11 (1.03 - 1.2) |
| 30 to 39 years | 1.193 | 4.42 | 21.463 | 5.13 | | 1.17 (1.1 - 1.24) |
| 40 to 49 years | 2.730 | 10.11 | 41.205 | 9.85 | | 0.97 (0.93 - 1.01) |
| 50 to 59 years | 5.432 | 20.11 | 75.131 | 17.96 | | 0.87 (0.84 - 0.9) |
| 60 years or more | 15.563 | 57.61 | 249.041 | 59.52 | | 1.08 (1.06 - 1.11) |
| **Sex** | | | | | **<0.001** | |
| Female | 14.822 | 54.86 | 236.058 | 56.42 | | 1.07 (1.04 - 1.09) |
| Male | 12.194 | 45.14 | 182.338 | 43.58 | | |
| **Race** | | | | | **<0.001** | |
| White | 2137 | 12.92 | 26548 | 10.87 | | 0.82 (0.78 - 0.86) |
| Black | 680 | 4.11 | 9134 | 3.74 | | 0.91 (0.84 - 0.98) |
| Brown | 12769 | 77.23 | 197548 | 80.90 | | 1.24 (1.2 - 1.29) |
| Yellow | 948 | 5.73 | 10965 | 4.49 | | 0.77 (0.72 - 0.83) |

**Source:** research data (2021).

Table 2 shows that older adults, women and brown individuals are the most prevalent among DM deaths, regardless of the nature of care. It was observed that there was no statistically significant association between the investigated variables.

**Table 2.** Deaths due to the nature of care according to age group, sex and race. Floriano, PI, Brazil, 2021.

| Variables | Character of service | | | | P-value |
|---|---|---|---|---|---|
| | Elective | | Urgency | | |
| | n | % | n | % | |
| **Age group** | | | | | 0.082 |
| Less than 10 years | - | - | 62 | 0.26 | |
| 10 to 19 years | 1 | 0.18 | 142 | 0.59 | |
| 20 to 29 years | 5 | 0.89 | 332 | 1.38 | |
| 30 to 39 years | 6 | 1.07 | 612 | 2.55 | |
| 40 to 49 years | 39 | 6.93 | 1297 | 5.40 | |
| 50 to 59 years | 62 | 11.01 | 2722 | 11.33 | |
| 60 years or more | 450 | 79.93 | 18854 | 78.49 | |
| **Sex** | | | | | 0.204 |
| Male | 232 | 41.21 | 9667 | 43.90 | |
| Female | 331 | 58.79 | 12354 | 56.10 | |
| **Race** | | | | | 0.0503 |
| White | 49 | 16.78 | 1303 | 11.69 | |
| Black | 13 | 4.45 | 413 | 3.70 | |
| Brown | 222 | 76.03 | 9095 | 81.58 | |
| Yellow | 8 | 2.74 | 332 | 2.98 | |

**Source:** research data (2021).

*The categories less than 10 years, and 10 to 19 years, were not included in the Chi-Square test because they have a very small amount of elective care.

## DISCUSSION

In this study, it was found that there were fluctuations in the mortality rate, with a decreasing trend, but without statistical significance. These data contrast with those of a study carried out in Rio Grande do Sul and Ribeirão Preto-SP, in which, respectively, the trend of mortality from DM remained stable during 2000 to 2020 and increased between 2010 and 2014.[18-19] However, it is noteworthy that the findings of this study may be related to the actions of the Family Health Strategy (FHS), considering that the increase in FHS coverage makes it possible to improve health care, which, in turn, can cause a reduction in the number of hospitalizations and mortalities due to preventable causes.[20]

Corroborating the findings of this study, in which hospitalizations were more frequent in older adults, women and browns, an ecological study, with data from the SUS, pointed to higher hospitalization rates among females and older adults, and an increasing trend in the groups of children and adolescents and browns.[12]

Females had a higher prevalence in the number of hospitalizations than males, focusing mainly on urgency. This is in disagreement with the findings of a study carried out in the capitals of the Southeast, between 2018 and 2021, in which most hospitalizations occurred in males.[21] A study conducted in Portugal on the impact of DM on multiple avoidable admissions showed that women are more likely to have multiple admissions.[22] This may be related to the factors that the woman has that may trigger a higher incidence in the number of hospitalizations, such as advanced age, family history of DM, hypertension, use of corticosteroids, polycystic ovary syndrome or having had, in a previous pregnancy, pre-eclampsia or eclampsia.[4]

This study showed that the brown race had a higher prevalence in the number of hospitalizations for DM, which corroborates the findings of the capitals of Belo Horizonte and Vitória, in which most hospitalizations also occurred in brown patients, and differs from São Paulo, which had a predominance of hospitalizations for DM in white patients.[21]

Thus, one study conducted in Piauí showed that the older adults between 60 and 69 years were the age groups that were most hospitalized for DM.[23] The higher number of hospitalizations in older age groups is noticeable and this may be related to the demographic aging process and the prevalence of risk factors for the development of diabetes mellitus that increases in this population, as well as complications, which imply a high number of hospitalizations and consequently a greater probability of increasing deaths.[24]

As for the number of deaths, there was a predominance of older adults, which corroborates the findings of a research carried out in Manaus, in which the mortality rate corresponded to 87.8% in this age group.[25] This fact may be associated with the degeneration of body systems that occur at this age, which are natural physiological processes and can provide greater fragility to these people, in addition to the lack of adequate care.[26]

In this study, deaths prevailed in the female public, which contrasts a study that sought to investigate sex differences in mortality trends due to diabetes mellitus in Brazil, 1980-2012, and concluded that DM in Brazil went from a pattern of higher mortality among women compared to men to equality or even male predominance.[27] However, a study carried out in São Paulo points out results similar to this study, which found a majority of predominantly female deaths from DM.[19]

The response to this higher mortality in women, especially in middle age, is considered to be due to the excess of work activity and daily family care that often overloads all their time, and this causes them to seek less and less or postpone going to the health service to screen problems, as well as the inequity that DM and other diseases bring to their lives.[28] In addition, this higher number of deaths in the female population is attributed to a higher number of diagnoses, treatment and notification of DM in female death certificates.[29] In addition, it is important to mention that mortality data can be underreported, since, frequently, in the death certificate, DM is not mentioned, but rather its complications, particularly cardiovascular and cerebrovascular complications.[6]

Regarding deaths by race, the study showed that the most predominant race was brown with 76.03% of elective deaths and 81.58% of emergency deaths, as well as in a study carried out in Manaus.[25] This may be related to the miscegenation of Brazil, as well as to the fact that the black and brown population suffer greater inequities imposed on the population, which demonstrates the need for more studies that follow these most affected groups with the purpose of formulating health actions with the purpose of reducing, above all, complications and, consequently, mortality from DM.[30]

It is important to highlight that the study has limitations regarding the unavailability of some information provided by the Hospital Information System (SIH-SUS) about the characteristics of patients and hospitalizations. With regard to contributions, we highlight the collaboration for the health of adults and the older adults, as this study identified that morbidity and mortality from DM affects, above all, older patients and this can provide opportunities for the development of public health policies that try to minimize the negative impact of DM on the health of this population.

## CONCLUSION

The epidemiological profile of hospitalization and mortality due to DM in the Northeast of Brazil is composed mainly of women, older adults and brown individuals, who were urgently treated. Regarding mortality, fluctuations were observed, but there was a decreasing trend.

It is noteworthy that these findings can contribute to the planning of prevention and health education actions for the population, together with health professionals, families and patients, in order to reduce the risks of complications considering the characteristics that the disease brings with it and all its challenges imposed throughout life and treatment, and therefore minimize hospitalizations and deaths due to preventable causes. In addition, it is important to strengthen existing actions and policies in Primary Health Care in order to provide improvements in patient care.

## CONTRIBUITIONS

Conception or design of the study: Máximo LWM, Araujo Filho ACA, Maranhão TA. Data collection: Máximo LWM, Araujo Filho ACA, Maranhão TA. Data analysis and interpretation: Máximo LWM, Araujo Filho ACA, Oliveira HFC, Lima JVS, Maranhão TA. Writing of the article or critical review: Máximo LWM, Araujo Filho ACA, Oliveira HFC, Lima JVS, Maranhão TA. Final approval of the version to be published: Máximo LWM, Araujo Filho ACA, Oliveira HFC, Lima JVS, Maranhão TA.

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